AMENDMENT TO THE SPECIFICATION

Please substitute the title of the invention to read as follows:

-- PARALLEL SIGNAL PROCESSING DEVICE ~~AND SIGNAL PROCESSING METHOD~~ FOR A PORTABLE AUDIO SYSTEM --

Please substitute the paragraph beginning at page 1, line 10 and ending at page 1, line 16 to read as follows:

-- Recently, for the sake of recording, downloading, and the like of an audio signal, techniques for a compressing/decoding process for a number of audio signals have been developed rapidly. As these types of compressing/decoding process techniques, Layer 3 of MPEG/AUDIO (MP3), Advanced Audio Coding (AAC), and the like are known. Any of these employs technologies, such as subhand encoding, MDCT, quantization, ~~Hoffman~~ Huffman encoding, and the like, as elemental technologies. --

Please substitute the paragraph beginning at page 3, line 10 and ending at page 3, line 12 to read as follows:

-- FIG. 6 is a block diagram showing a signal processing device performing audio signal decoding in accordance with ~~a~~ the concrete example of Embodiment 1. --

Please substitute the paragraph beginning at page 3, line 16 and ending at page 3, line 17 to read as follows:

-- FIG. 8 is a time chart showing a flow of signal processing of Embodiment 1 of the present invention in ~~the~~ order of time. --

Please substitute the paragraph beginning at page 3, line 20 and ending at page 3, line 21 to read as follows:

-- FIG. 10 is a time chart showing a flow of signal processing of Embodiment 2 of the present invention in ~~the~~ order of time. --

Please substitute the paragraph beginning at page 4, line 5 and ending at page 4, line 6 to read as follows:

-- FIG. 14 is a block diagram showing a flow of the signal processing of Embodiment 3 of the present invention in ~~the~~ order of time. --

Please substitute the paragraph beginning at page 4, line 9 and ending at page 4, line 10 to read as follows:

-- FIG. 16 is a time chart showing a flow of the signal processing of Embodiment 4 of the present invention in ~~the~~ order of time. --

Please substitute the paragraph beginning at page 4, line 15 and ending at page 5, line 2 to read as follows:

-- DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a flow of processing in the case where signal processing composed of a first process A and a second process B is performed without being made parallel in a signal processing device. FIG. 2 shows a flow of the process A and the process B

in the case where the processing shown in FIG. 1 is made parallel. In these examples, one frame period is T. When the processing is not made parallel, first, the first process A [1] is performed for an input frame signal [1] as shown in FIG. 1, and then the second process B [1] is performed to generate an output frame signal [1]. In the next frame period, the process A [2] is performed for an input frame signal [2], and then the process B [2] is performed to generate an output frame signal [2]. Thus, the processing of the process A and the process B ~~together~~ is completed <u>together</u> within the one frame period T. --

Please substitute the paragraph beginning at page 5, line 12 and ending at page 5, line 17 to read as follows:

-- With this parallel processing, although both the process A and the process B together have to be completed within the period T originally as shown in FIG. 1, it becomes possible that each one of the process A and the process B is completed within the period T, whereby 1/2 of calculation capability becomes sufficient. That is, the operation frequency for the processing can be made ~~1/2~~ <u>in half</u>, and thus the power consumption is reduced. --

Please substitute the paragraph beginning at page 6, line 5 and ending at page 6, line 15 to read as follows:

-- Although the process A and the process B are performed ~~with~~ in parallel as described above, in this type of parallel processing, the processing in which the process A is originally completed within a period 2 × T / 3 merely comes to be allowed to be completed within a maximum of the period T ~~at the most~~. With respect to the process B, the process is completed in a sufficiently short period, compared with the given period T. Therefore, dead time in which no processing is performed is generated in the processing device B, and thus reduction in power consumption cannot be executed efficiently even by the parallel processing. The inventors ~~are to find~~ found out and ~~solve~~ solved the problem in the case where the audio signal processing is made parallel ~~in audio signal processing~~. --

Please substitute the paragraph beginning at page 7, line 1 and ending at page 7, line 15 to read as follows:

-- FIG. 5 shows a configuration of a signal processing device according to the present embodiment. This signal processing device has one main signal processing section 10 and first to third ~~three~~ sub signal processing sections 11 to 13. A distribution section 14 distributes a frame signal of the input to ~~either~~ one of the sub signal processing sections 11 to 13 in accordance with a frame number. A selection section 15 selects ~~either~~ one of the sub signal processing sections 11 to 13 in accordance with the frame number to send it to the main signal processing section 10. A frame number management section 16 updates the frame number each time one frame period T elapses to give the number to the distribution section 14 and the selection section 15. Here, it is supposed that the respective sub signal processing sections 11 to 13 have the capabilities to process the first process A within the time period 3 × T, and the main signal processing section 10 has the capability to process the process B within the time period T. --

Please substitute the paragraphs beginning at page 7, line 24 and ending at page 9, line 6 to read as follows:

-- The first digital signal may, for example, be a compressed and encoded signal of an audio signal, and the second digital signal may be a PCM signal of an audio signal. The first process may contain a process picking out information from that compressed and encoded signal and converting that information into the information of a frequency spectrum, and the second process may contain a process converting the information of that frequency spectrum into a time ~~base~~ based PCM signal.

FIG. 6 is a block diagram showing a signal processing device performing an audio signal decoding process that is a concrete example of the present signal processing device. This audio signal decoding processing device has first to third ~~Hoffman~~ Huffman decoding sections 111, 121, and 131 as the sub signal processing sections 11 to 13 performing the first process A. The ~~Hoffman~~ Huffman decoding process is a decoding process of a variable length code for decoding encoded information for each frame from an encoded input bit stream ~~of the input~~. It is supposed that the main signal processing section 10 performing the second process B is an inverse MDCT processing section 101. The inverse MDCT process is a process performing an inverse MDCT process for a signal inversely quantized.

Another example of the audio decoding processing device is shown in FIG. 7. It can be set that the sub signal processing sections 11 to 13 are inverse quantizing sections 112, 122, 132 inversely quantizing encoded ~~informing~~ information and that the main signal processing section 10 is a sub-band synthesis filter bank processing section 102.

FIG. 8 is a view showing a time sequenced flow of the processing of the signal processing device of the present embodiment ~~in the order of time~~. Operations of the signal processing device will be explained below. First, the frame number management section 16 outputs a frame number incremented for each frame period to the distribution section 14 and the selection section 15. The distribution section 14 sends the frame signal to the (i+1)th sub signal processing section when the frame number is (N × t + i) (t and i are integers, and $0 \leq i < N$). In this case, N is 3. As shown in FIG. 8, each frame signal is distributed to a predetermined sub signal processing section one after another. --

Please substitute the paragraph beginning at page 11, line 7 and ending at page 11, line 10 to read as follows:

-- Since the processing employing the information generated in the past frame time is excluded in the first process A, the need to deliver a signal between the respective sub signal processing sections is eliminated, whereby ~~making~~ the ~~processing parallel~~ parallel processing can be efficiently performed. --

Please substitute the paragraph beginning at page 12, line 4 and ending at page 13, line 7 to read as follows:

-- FIG. 9 is a block diagram showing a configuration of the signal processing device according to the present embodiment. The signal processing device has one main signal processing section 30 and first and second ~~two~~ sub signal processing sections 31 and 32. A distribution and selection section 33 distributing and selecting to output each frame signal is provided between the main signal processing section 30 and the sub signal processing sections 31 and 32. A frame number management section 34 updates the frame number each time one frame period T elapses to output it to the distribution and selection section 33. A first memory 35 is a memory storing an input frame signal one after another, and a second memory 36 is a memory storing an output frame signal one after another. Here,

it is supposed that the sub signal processing sections 31 and 32 have the capabilities to process the first process A within the time period (2 × T), and the main signal processing section 30 has the capability to process the second process B within the time period T.

Here, similar to Embodiment 1, since the first process A has to start the process of the next frame time before the process of the past frame time is completed, it is necessary that the process A is the non-chain process. Conversely, the second process B can be the chain process. This is because the processing of the next frame time is always started after the process of the past frame time is completed. Therefore, similar to Embodiment 1 described above, it is possible to construct a signal processing device for decoding an audio signal, setting that the main signal processing section 30 performs an inverse MDCT process and the sub signal processing sections 31 and 32 perform a ~~Hoffman~~ Huffman encoding process. It is possible to select the inverse quantize process as the first process A performed in the sub signal processing sections 31 and 32 and a sub-band synthesis filter bank process as the process B performed in the main signal processing section 30. --

Please substitute the paragraph beginning at page 15, line 10 and ending at page 15, line 14 to read as follows:

-- Constructing the process A so that the process A excludes a process employing the information generated in a past frame time eliminates the necessity to deliver a signal between the respective sub signal processing sections, whereby ~~making~~ the processing parallel can be efficiently performed. --

Please substitute the paragraph beginning at page 15, line 24 and ending at page 16, line 13 to read as follows:

-- FIG. 11 shows a configuration of a signal processing device according to the present embodiment. The signal processing device has one main signal processing section 50 and first to third ~~three~~ sub signal processing sections 51 to 53. A distribution section 54 distributes an output signal from the main signal processing section 50 to ~~either~~ one of the sub signal processing sections 51 to 53 in accordance with the frame number. A selection section 55 selects the output signal of ~~either~~ one of the sub signal processing sections 51 to 53 in accordance with

the frame number to output it. A frame number management section 56 updates the frame number each time one frame period T elapses to give it to the distribution section 54 and the selection section 55. Here, it is supposed that the main signal processing section 50 has the capability to process the first process A within the time period T, and the respective sub signal processing sections 51 to 53 have the capabilities to process the process B within the time period (3 × T). --

Please substitute the paragraphs beginning at page 17, line 1 and ending at page 17, line 21 to read as follows:

FIG. 12 is a block diagram showing a signal processing device performing an audio signal encoding process that is a concrete example of the present signal processing device. This audio signal encoding processing device can employ an MDCT processing section 501 as the main signal processing section 50 performing the first process, and first to third ~~Hoffman~~ Huffman encoding sections 511, 521, and 531 as the sub signal processing sections 51 to 53 performing the second process as shown in FIG. 12. The MDCT process is a process converting the PCM signal in which the input is framed into a frequency spectrum signal while

overlapping with the past PCM signal. The ~~Hoffman~~ Huffman encoding process is, ~~that is~~, a variable length encoding process in which the present frame signal can be processed without employing the data generated at the time of the past frame processing.

Fig. 13 shows another example of the audio encoding processing device. It can be set so that the main signal processing section 51 is a sub-band analysis filter bank processing section 502 and that the sub signal processing sections 51 to 53 are first to third quantizing sections 512, 522 and 532.

FIG. 14 is a view showing a flow of processing of the signal processing device in ~~the~~ order of time. Operations of this signal processing device will be explained below, employing FIG. 11. --

Please substitute the paragraph beginning at page 18, line 25 and ending at page 19, line 7 to read as follows:

-- The selection section 55 then inputs the signal for which the process A and the process B are performed from ~~either~~ one of the sub signal processing sections 51 to 53 to output this

processed signal. In general, when the frame number shown by the frame number management section 56 is (N × t + i), the signal outputted from the (i + 1)th sub signal processing section is outputted. The signal outputted at this time becomes the signal which is obtained by performing the process B for the signal inputted to the (i + 1)th sub signal processing section at the (N × (t - 1) + i)th frame time. Here, N=3. --

Please substitute the paragraph beginning at page 20, line 8 and ending at page 20, line 14 to read as follows:

-- In the ~~forth~~ fourth frame time, the fourth frame signal is inputted to the main signal processing section 50, and for this signal the process A [4] is started. At the same time in the first sub signal processing section 51, the process B [3] is started for the output signal for which the process A [3] is completed from the main signal processing section 50 so that this process is completed within the period (3 × T). Of course, the process A is completed within the period T. --

Please substitute the paragraph beginning at page 20, line 22 and ending at page 21, line 1 to read as follows:

-- Constructing the process B so that the process excludes ~~a process processing~~ employing the information generated in the past frame time eliminates the necessity to deliver a signal between the respective sub signal processing sections, whereby making the processing parallel can be efficiently performed. --

Please substitute the paragraph beginning at page 22, line 10 and ending at page 22, line 23 to read as follows:

-- Here, similar to Embodiment 3, the first process A can be a process in which the information generated in the past frame time is employed, that is, the chain process. This is because the process of the next frame time is always started after the processing of the past frame time is completed. Conversely, since the second process B has to start the process of the next frame time before the process of the past frame time is completed, it is necessary that the process B is the non-chain process. Therefore, similar to Embodiment 3 described above, it is possible to construct an audio coding processing device

performing an MDCT process as the main signal processing section 70 and the ~~Hoffman~~ Huffman encoding process as the sub signal processing sections 31 and 32. It is possible to select a sub-band analysis filter bank process as the process A performed in the main signal processing section 70 and a quantize process as the process B performed in the sub signal processing section 30. --